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(G*) Harvesting Entanglement inside a Black Hole

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We carry out the first investigation of the entanglement and mutual information harvesting protocols for detectors moving on freely falling trajectories that cross the horizon of a black hole. We consider two pointlike Unruh-DeWitt detectors in different combinations of free-falling and static trajectories in (1+1)-dimensional Schwarzschild black hole spacetime and compare the results. We find that (i) correlations harvested between free-falling and static detectors are always less than those of the familiar two-static-detector case (ii) there is a large kinematic component to the correlations; (ii) correlations can be harvested purely from the quantum vacuum, with evidence that this is possible even when the detectors are causally disconnected by the event horizon; (iii) the previously known 'entanglement shadow' near the horizon is indeed absent for the two free-falling-detector case since the relative gravitational redshift of the detectors remains finite as the horizon is crossed, in accordance with the equivalence principle.

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